Universitatea POLITEHNICA din Bucureşti
Facultatea de Automatica si Calculatoare

Program de master

Service Engineering and Management (SEM)

Tip: Complementar, 4 semestre

1. Obiectivele programului.

- *The demand for service innovation*

The new Master program "**Service Engineering and Management**" responds to the present worldwide demand of service innovation. The scale and complexity of globally dispersed *service systems* is growing rapidly and the importance of using resources efficiently, effectively and in a sustainable manner is rising, as service activities become an ever greater part of value creation in modern economies. Proportionally, we are paying more for experience, advice, information, assurances, use of infrastructures and leasing, and less on growing, building and owning physical goods.

In such a rapidly changing and increasingly complex world, service innovation requires new skills and deep knowledge that underpins the skill set. People are needed who can understand and marshal diverse global resources to create value. Frequently these resources are accessed using advanced information and communication technologies (ICT) and new globe-spanning business models. The people with new skills for service innovation are sometimes known as *adaptive innovators* for the continuous stream of improvement they identify and realize. *Service innovation can improve customer-provider interactions and the experience of finding, obtaining, installing, maintaining, upgrading and disposing of products*. Service innovation can enhance the capability of organizations to create value with key stakeholders. Service innovation can improve the quality of life of the individuals and help the society deal with issues such as aging population. Service innovation can enable self service that eliminates waiting and allows 24/7 access via modern devices: mobile phones, web browsers, etc.

The emergence of **Service Science** or **Service Science, Management and Engineering (SSME)** is a story of gradual identification of numerous areas of study: *service economics, service marketing, service operations, service management, service engineering, service computing, service sourcing*, *service human resources management, service design,* a.o.

Despite important development in the service field over the past few decades, there has been a growing perception that a more integrated approach is needed if real progress is to be made. With the demand for service innovation being much in evidence, it is time to take stock and to explore the possibility of bringing coherence into the emerging strands of knowledge and experience. Without a clear understanding of the domain and its connections with existing theories, knowledge will continue to be fragmented.

The changing global landscape of business and society can be described, for the purpose of increasing service innovation, as a very large global service system, which is made up of many smaller *service systems* (individuals, businesses and government agencies) interacting via *value propositions* to exchange service for service and to co-create value during the process. In such context, *adaptive innovators* will need to have knowledge of an emerging field known as *Service Science, Management and Engineering (SSME)* or *Service Science* for short. Considering the integral role of design and the arts, SSME could logically be extended to SSMED or SSMEA (Service Science, Management, Engineering and Design/Arts).

- *Defining the domain*

The shift to service as the driver of economic growth is clear. Statistics indicate that employment in developed economies is dominated by people working in service industries and the public sector.

A service system can be defined as a dynamic value co-creation configuration of resources, including people, technology, organizations and shared information (language, laws, measures and methods), all connected internally and externally by value propositions, with the aim to consistently and profitably meet the customer's needs better than competing alternatives. In many cases, a service system is a complex system in that the configuration of resources interacts in non-linear ways. Interactions take place at the interface between the provider and the customer and, with the advent of ICT, of customer-to-customer and supplier-to-supplier interactions become prevalent.

As such, a service system is more than the sum of its parts and, through complex interactions, the parts create a system whose behaviour is difficult to predict. In the real world, however, service systems typically interact to jointly create value, and yet frequently fail to meet expectations. The disappointments reflect a lack of sound understanding of the science underlying the design and operation of the increasingly complex service systems. New knowledge is required to systematically describe the nature and the behaviour of service systems.

We still need specialists to deal with the increasing complexity but, to extract the full potential of service systems, we must seek to understand (1) how to optimally invest in service systems to improve in a sustainable way key performance indicators (customer satisfaction, productivity, regulatory compliance, innovation capabilities) and (2) how to create new service offerings based on improved value propositions or new types of service systems.

Service science is about integration, optimization and sustainability. This includes discovery, innovation and application of best practices. In complex business, technological and societal systems, we currently lack understanding of the full value potential of resources over their lifecycles.

Service science aims to provide a clear and common understanding of service system complexity. We have pieces today, but existing knowledge is not integrated into a unified whole.

Service science provides motivation, methods and skills for integration. Service science has the potential to benefit individuals, businesses and society, drawing upon the integrated talents of a diverse community of academics, industry, governments, entrepreneurs, as well as non-profits. Service science will enable adaptive innovators to identify the seeds around which service innovation can take root and grow.

Individuals and institutions dependent on complex, interconnected service systems are all stakeholders in understanding and improving service system performance and sustainability. Businesses that want to improve their service revenues and profit margins are clearly stakeholders, including both incumbent firms and small and medium enterprises (SME). Their counterparts in the non-profit sector are also stakeholders who share similar concerns and aspirations. Governments, be they national, state, county or local, wishing to improve their competitiveness in the service economy are important stakeholders. A key question for governments is how they can help create a high skilled workforce, and legislative, social, technological and environmental infrastructures to enable service innovation.

The growing complexity of products, businesses and government agencies, households in urban and rural environments, and shared on-line information spaces requires a solid scientific foundation for the study of service systems. Service science has the potential to be as important as the foundation provided by physics, chemistry, biology, cognitive science and computer science. Service scientists, engineers and managers could well be just the type of adaptive innovators needed to create the next generation of service innovations.

- *Identifying and working together to bridge the gaps*

Service science covers all types of value-creating resources, and the disciplines or competencies that study and apply them. There are nearly a dozen of strands that study resources or approaches to integrating resources of service systems. They can be clustered in four areas:

A1. Business and organizations as a resource: Faculties and Schools of Management (operations management, marketing, industrial marketing, human resource management, strategy, innovation, financial engineering, value engineering),

A2. Technology as a resource: Faculties and Schools of Science and Engineering (systems design, engineering, software metrics, software development, product and software architecture, design),

A3. People as a resource: Faculties and Schools of Social Science and Humanities (psychology, economics, sociology, behavioural sciences, arts, design, innovation),

A4. Information as a resource: Faculties and Schools of Information (ICT, simulations)

Discovering fundamental building blocks of service systems, and how they can be combined to create the variety of service systems, service interactions and outcomes observed in the world, is already underway. Resource classification schemes are also being developed, along with associated access rights, service level agreements, standards and protocols, safeguarding designs and failure recovery methods. Despite the significant progress, there are wide gaps in the knowledge of service systems. At the level of individual specialized disciplines, challenges still exist. For example, while operational research and industrial engineering often model people waiting in queues, yet more realistic understanding of people as resources that are emotionally and psychologically sensible and that can learn and adapt over time is lacking.

Computer science and information science often model information systems (composed of hardware and software) as architectures optimized to respond to well understood environmental demand variations. Nevertheless, the design of governance mechanisms that allow information systems to proactively respond to strategy changes and predictable technological advances is less understood. The disciplines of economics and business strategy need to account better for predictable innovations. Service management and operations need to create better knowledge of service system scaling and lifecycles. Law and political economy need a better comprehension of social innovation, and the way that passing a law can improve service system productivity. The emerging discipline of complex systems engineering should provide more specific insights into the robustness and fragility of service systems.

Beyond the level of individual disciplines, there are more fundamental challenges in integrating various strands of knowledge. While knowledge specialization remains important, one shortcoming is that each individual discipline tends to concentrate on particular resources (people, technology, organizations, or information) or particular configurations of resources. Academics have well defined research agenda within their communities to deal with discipline-specific issues, but the complexity of service systems requires an integrated approach. The key to understanding service systems is not just to examine one aspect of service but rather to consider service as a system of interacting parts. It requires bridging many types of resources, for example, service marketing (customer as key resource), service operations (process as key resource), service computing (information and IT as key resource), service human resource management (employees as key resource), service sourcing (whole organizations and value chains as key resource), and so on. As service systems become more complex, the cross disciplinary knowledge gap poses more constraints to our ability to understand them. The hard work of creating an integrated theory that spans many disciplines, however, has not been done.

The *knowledge gap* stems from the tradition that institutions are structured along discipline and sub discipline lines and academic silos are created to encourage deeper understanding of a specialized subject (see Fig. 1). There is expectation, from institutions and funding bodies, that academics conduct research and provide courses within their disciplines.

Although often addressing similar matters, each discipline or function usually has an implicitly agreed (presumed) set of interests, paradigms and methodologies. Over time, academics see cross disciplinary research as being highly risky and potentially career-damaging. As a result, there is an imbalance in service research; studies tend to focus too much on either customer (marketing) or provider (operations). This is reflected, and indeed reinforced, by top journals, which tend to be highly specialized. In operations management journals, for example, less than 20 percent of the papers focus on service topics contrasting with the around 80 percent of service activities in the economy. In addition, some of the disciplines tend to focus on specific sectors; marketing tends to be concerned with business-to consumer and operations with business-to business.

Ultimately, the knowledge gap leads to a mismatch between academic focus and practical interest in the broad area of service innovation.

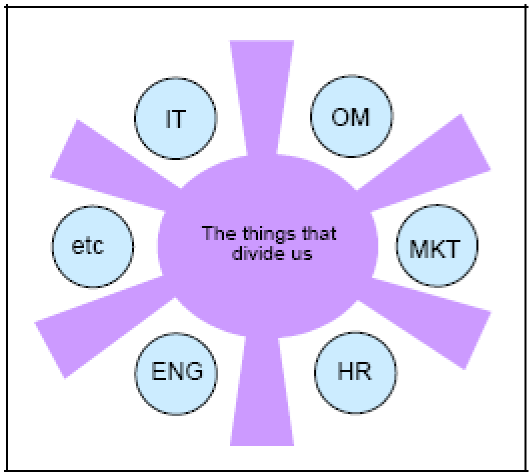

Fig. 1 – The gaps between academic disciplines (IT – Information Technology, OM – Operations Management, MKT – Marketing, HR – Human Resources, ENG – Engineering)

In addition to the knowledge gap, the supply of people with the right skills is inadequate as the service economy continues to grow. The role of education in the 20th century was in part to prepare students for jobs. Universities have been conventionally rewarded for creating people with specialized knowledge. Service innovation, however, requires an extended role of education in the 21st century. Universities must prepare people to be *adaptive innovators*, who are as deeply skilled in their home discipline as before, but with additional entrepreneurial skills and capable of systems thinking in many project roles they may fill during their professional lives.

The mismatch between supply and demand of knowledge and skill in dealing with service systems underscores a more systematic approach to both research and education. As shown in Fig. 2, there are three ways to address the integration gap. To some, service science is seen as a *"super" multidiscipline* embracing all appropriate, but as yet not agreed, disciplines and functions. To some others, service science is seen as a *multi-discipline*, embracing elements of the major disciplines and functions. Alternatively, service science can be an *inter-disciplinary* activity which attempts to unite various areas based on trans-disciplinary (or cross disciplinary) collaboration.

The inter-disciplinary approach brings benefits to both academia and practice. From a practical perspective, the approach would lead to a rigorous methodology to invest in the improvement of service systems and the design of high-value service offerings. From an academic perspective, to the approach would provide a rigorous foundation for many interrelated disciplines so that research and education could be more rapidly advanced.
Inter-disciplinary activities are not new to research and practice. They are in evidence in many universities and industries. Indeed there is an established body of knowledge about how to undertake inter-disciplinary work, which can be improved and tuned to service research. There are opportunities at every level to address the barriers between disciplines and the study of service systems.

Individual: Leaders in both practice and academia are well placed to highlight the excitement of interdisciplinary work and to reduce the risks sometimes associated with moving outside specialism or discipline. The potential of service systems to improve society as well as business offer the potential to draw sophisticated and broadly capable people to the field. Leaders can help to develop, articulate and enable aspiration service activities.

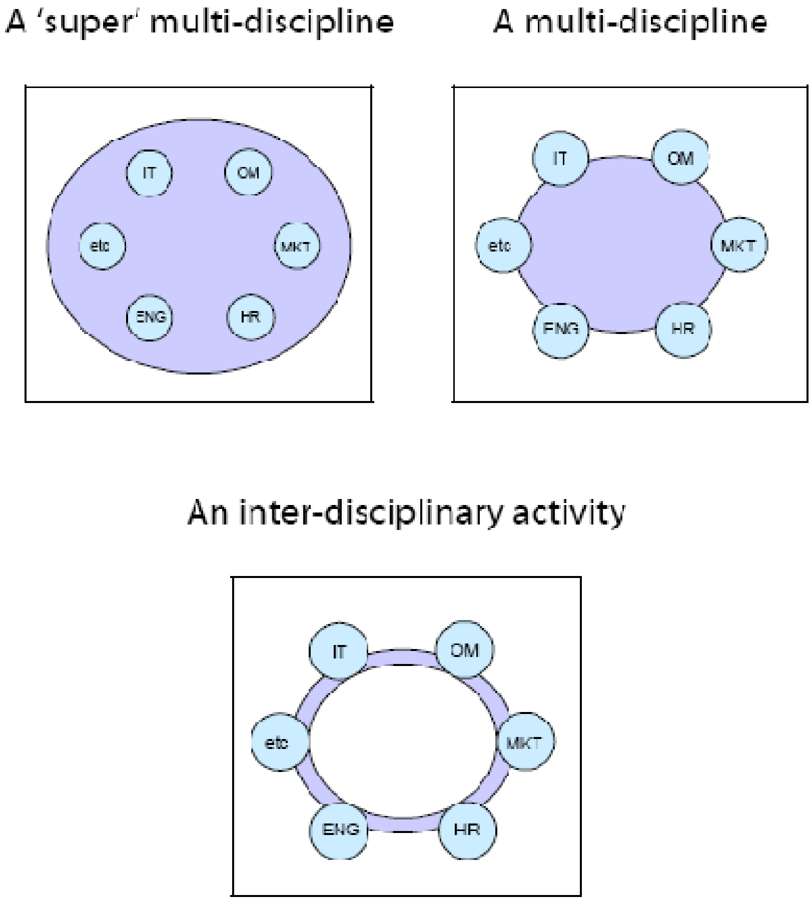

Fig. 2 –Three perspectives of service science

<u>Structural</u>: Inter-disciplinary or cross-functional work happens at a project or activity level. Cross-functional teamwork on specific projects with common goals encourages mutual awareness and respect for other disciplines. Exemplary individuals, teams, projects and outputs, such as case studies, provide a vehicle for encouraging more cooperative behaviours, common purpose and non discipline / functional-based language and mindsets. However, the need for rigour and relevance in interdisciplinary service research remains particularly important in order that new knowledge and practices are seen to be robust and reliable. A shared belief in customer orientation can provide an important common focus.

<u>Business</u>: Business challenges are often interdisciplinary and cross-functional. Business problems commonly require participants with different disciplinary backgrounds to learn enough about each other's perspective (conceptually, methodologically and substantively) for the purpose of effective and productive work. Challenges clearly expressed in the language of business can cross academic boundaries and demonstrate that no single academic community has exclusive 'ownership' of the problem. Businesses can also provide hard data for academic research to support the pursuit of robust and practical outcomes. Industrial structures focused on services are already emerging and businesses can encourage the development of service

professionals, service fellows in academia and the well articulated cultivation of a service ethos. Hiring policy might usefully recognize the importance of psychological capital and customer empathy.

Academia: Leading journals in the field of service research are extremely influential in setting the agenda and tone of academic research. They are uniquely placed to encourage inter-disciplinary studies. In addition to leading journals of interdisciplinary/ cross-functional research, major specialized journals are encouraged to initiate special issues in inter-disciplinary areas. This is not straightforward and more work is needed to define and document more precisely what constitutes 'good' inter-disciplinary research. Funding bodies should be part of the process towards more interdisciplinary research so that they can assess research proposals more consistently. Close partnerships with industry can help academics to develop relevant research agenda leading, in due course to the development of inter-disciplinary tools, models and frameworks that reflect interactions between a firm's different departments and its external partners. Modern web-based communication tools may enable the required multi-disciplinary social networks to form and work together as needed to move from silos of knowledge to connected and integrated webs of knowledge.

Funding and Incentive: Except in certain areas of physics and mathematics, the incentive and the methods of creating integrated theories that span multiple areas is not well known. In addition to discipline-specific studies, funding should also be provided to support inter-disciplinary service research, through mechanisms such as dual appointments and shared rewards. More fundamentally, funding should not be biased towards narrowly defined disciplines; it should be granted on the basis of the research's potential to advance knowledge and practice.

In response to the skill gap, however, the University Politehnica of Bucharest should offer students the opportunity to gain qualifications in SSME, by handling the "Service Management and Engineering" Master program (SEM). Such qualifications would equip graduates with the concepts and vocabulary to discuss the design and potential redesign of service systems from inter-disciplinary perspectives. Industry often refers to "**T-shaped professionals**", who are deep problem solvers in their home discipline, but have the competence to interact with and understand specialists from a wide range of disciplines and functional areas. T-shaped professionals are more likely to become adaptive innovators.

Widely recognizing this SEM program would help ensure the availability of a large population of T-shaped professionals with the ability to collaborate to create service innovations. SEM education and qualifications would indicate that these graduates could communicate with scientists, engineers, managers, designers, and many others involved in service innovation. In many areas of the economy, competition will be greatest for new service experiences that delight customers with unique aesthetics and artistic design (expression and personalization), not just low costs and productivity (functionality and standardization).

Graduates with SEM qualifications would be prepared with concepts and vocabulary to "hit the ground running" when joining a service innovation project, immediately productive for the employer, and paying significant dividends to the project.

Clearly, rapid progress in the design and delivery of the SEM program would require active support and resources from business and government.

2. Competente generale si specifice

Competente generale

The main objective of the 2-year interdisciplinary "**Service Engineering and Management**" master program, derived from this analysis of the demand for multi-facet service innovation, is to provide the following basic components in the education of service professionals, clearly requested by the economy of the 21st century:

- *New technologies* (i.e. the ability to design, understand and evaluate innovative technologies and processes)
- *New interaction modes or services* (i.e. understand user and consumer needs and be able to meet requirements and quality expectations)
- *New business models* (i.e. leadership and management capacity to meet stakeholder interests and the demand for organization flexibility, effectiveness and accountability)

Thus, general competencies of SEM graduates derive from study and approaches to **integrate resources of service systems:**

(1) **Business** and **organisations as a resource** (operations management, marketing, industrial marketing, human resource management, communication management, strategy, innovation, financial engineering, value engineering)

(2) **Technology** as a resource (systems design, engineering, software metrics, software development, product and software architecture, design)

(3) **People** as a resource (psychology, economics, sociology, behavioural sciences, arts, design, innovation, intellectual property)

(4) **Information** as a resource (ICT, simulations)

Competente specifice

Specific competencies derive from the general ones above defined. The new Master program in **Service Engineering and Management** (SEM) is still a program to educate professional engineers, i.e. graduates will be prepared to *conceive, design, implement* and *operate* (CDIO) *complex value-added engineering systems*. SEM has a strong emphasis on:

1. Understanding the innovative <u>technologies</u> now required for service provision.
2. Understanding the functional and the experience requirements of <u>people</u> using services.
3. <u>Management</u> of the service CDIO lifecycle process and understand its value.

Specific competencies are provided by three complementary hands-on training modules: ICT (**Information and Communication Technologies**), PSO (**Psychology** and **Sociology**), and OMM (**Operations, Management** and **Marketing**); as an integrative force, the specific scope and related competencies include contributions from that map into the four fundamental resource categories (1) – (4) as represented in Table 1.

Presenting an integrated theory of service activities and service systems, as well as practitioner driven tools, methods and data sets will provide the specific competencies. Some of these tools are used to model government agencies and public sectors, and businesses.
Other presented tools and methods were developed for modelling industries as a system of business components with associated key performance indicators (KPIs). Finally, specific competencies come from the development of service-oriented architectures (SOA) for describing information technology "services" that support work and business practices.

The employment options for SEM Master graduates are

- Service management
- Business ecosystem analysis and modelling
- CDIO of complex value-added engineering systems
- Internal and external consulting for enterprise management
- Strategic business development for enterprise structures, supply chains and services
- Enterprise modelling and integration

Table 1 - Specific competencies for SEM Master Project

ICT – Information & Communication Technologies	PSA – Psychology, Sociology and Arts	OMM – Operations, Management & Marketing
Mobile technologies Information systems Human-Computer Interaction Internet technologies Multimedia technologies	Sociology of Organizations Cognitive Psychology Communication Information science and management Design	Service marketing Service Operations and Management Financial management Management of Innovation Service design and development

3. PLAN DE ÎNVĂȚĂMÂNT

Anul I - semestrul I

Cod	Denumirea disciplinei	Semestrul I - 14 săptămâni					
		C	S	L	P	p.c.	Evaluare (E/V/P)
C11	Mathematical Modelling of Economic Processes	2		1		4	E

C12	Business Process Modelling, Strategies and Communication	2		1		3	V
C13	Information Management and Data Warehousing	2			1	3	E
C14	Information Systems Architecture	2			1	3	E
C15	Marketing and Financial Performance of Business	2		1		3	V
C16	Network and Systems Security	2			1	4	E
	Scientific Research / Development	12 hours / week				10	P
	Total					**30**	

Anul I - semestrul II

Cod	Denumirea disciplinei	Semestrul II - 14 săptămâni					
		C	S	L	P	p.c.	Evaluare (E/V/P)
C21	Service Operations Management and Logistics	2		1		4	E
C22	Business Process Management	2			1	3	E
C23	Multimedia and New Services	2			1	4	E
C24	Knowledge Engineering and Management for Services	2		1		3	V
C25	Communication Management and Cognitive Psychology	2	1			3	V
C26	Accounting and Financial Management	2		1		3	E
	Scientific Research / Development	12 hours / week				10	P
	Total					**30**	

Anul II - semestrul I

Cod	Denumirea disciplinei	Semestrul III - 14 săptămâni					
		C	S	L	P	p.c.	Evaluare (E/V/P)
C31	Supply Chain Management	2			1	4	E
C32	Data Workflow and Computer Networks	2		1		3	E
C34	Enterprise Management Architectures	2		1		3	E
C36	E-Business Technologies	2			1	3	E
	Scientific Research / Development	18 hours / week				17	P

	Total					**30**	

Anul II - semestrul II

Cod	Denumirea disciplinei	Semestrul IV - 14 săptămâni					
		C	S	L	P	p.c.	valuare (E/V/P)
C41	Project Management	2			1	3	E
C33	Capital Budgeting	2	1			3	V
C35	Organizational Behaviour and Customer Relationship Management	2			1	3	V
C42	Intellectual Property and Entrepreneurship	2		1		3	E
	Scientific Research / Development	6 hours / week				6	P
	Master project	12 hours / week				12	P
	Total					**30**	

4. Personalul didactic existent în facultate care va fi implicat în programul de master.

Professor Theodor Borangiu. PhD
Professor Marius Guran, PhD
Professor Dorin Carstoiu, PhD
Professor Daniela Saru, PhD
Professor Valentin Cristea, PhD
Professor Anca Ionita, PhD
Professor Adrian Curaj, PhD
Professor Anamaria Ciobanu, PhD
Professor Aurelian Mihai Stanescu, PhD
Professor Laura Pana, PhD
Senior Reader Ecaterina Oltean, PhD
Senior Reader Liliana Dobrica, PhD
Lecturer Madalin Vlad, PhD
Lecturer Florin Pop, PhD
Lecturer Maximilian Nicolae, PhD
Lecturer Florin Anton, PhD
Lecturer Meral Kagitci, PhD
Lecturer Maria Pascu, PhD\
Lecturer Alexandru Costan, PhD
Lecturer Silvia Anton, PhD
Lecturer Stefan Mocanu, PhD

Lecturer Silviu Raileanu, PhD
Lawyer David Oprea, PhD
Assistant Raluca Tudorie, PhD Student

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